FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 27428/37727

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): 09/937995

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/02773	29 March 2000	1 April 1999

TITLE OF INVENTION
INFRARED IRRADIATION

APPLICANT(S) FOR DO/EO/US
KAI K.O. BAR and RAINER GAUS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b ☒ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☒ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☐ Other items or information:

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/937995	PCT/EP00/02773	27428/37727

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1000.00
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	$860.00
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT = $860.00

Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)). $0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	12 - 20 =	0	x $18.00	$0.00
Independent claims	2 - 3 =	0	x $80.00	$0.00
Multiple Dependent Claims **(check if applicable)**.			☐	$0.00

TOTAL OF ABOVE CALCULATIONS = $860.00

☐ Applicant claims small entity status. (See 37 CFR 1.27). The fees indicated above are reduced by 1/2. $0.00

SUBTOTAL = $860.00

Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). + $0.00

TOTAL NATIONAL FEE = $860.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐ $0.00

TOTAL FEES ENCLOSED = $860.00

Amount to be: refunded	$
charged	$

a. ☒ A check in the amount of **$860.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **13-2855** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Nate F. Scarpelli
MARSHALL, GERSTEIN & BORUN
233 South Wacker Drive
6300 Sears Tower
Chicago, Illinois 60606-6402
Tel.: (312) 474-6300
Fax: (312) 474-0448

SIGNATURE

Nate F. Scarpelli
NAME

22,320
REGISTRATION NUMBER

September 28, 2001
DATE

PATENT
27428/37727

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

APPLICANT:	) "EXPRESS MAIL" mailing label) No. EL 564463305 US.
KAI K.O. BÄR, ET AL.	) Date of Deposit:) September 28, 2001
SERIAL NO.: To Be Determined	) I hereby certify that this) paper (or fee) is being) deposited with the United
FILED: Filed Herewith	) States Postal Service "EXPRESS) MAIL POST OFFICE TO ADDRESSEE"
FOR: INFRARED IRRADIATION	) service under 37 CFR §1.10 on) the date indicated above and
GROUP ART UNIT: To Be Determined	) is addressed to: Assistant) Commissioner for Patents,) Washington, D.C. 20231
EXAMINER: To Be Determined	)) Richard Zimmermann

PRELIMINARY AMENDMENT "A" ACCOMPANYING
SECTION 371 NATIONAL STAGE APPLICATION AS FILED

Commissioner for Patents
BOX PCT
Washington, D.C. 20231

Sir:

Please amend the above-identified accompanying Section 371 national stage application as filed as follows:

IN THE SPECIFICATION:

Page 1, replace the heading with the following centered heading: --BACKGROUND OF THE INVENTION--.

Page 3, replace the paragraph beginning at line 16 with the following centered heading: --SUMMARY OF THE INVENTION--.

Page 10, before line 5, insert the following centered heading before the first full paragraph: --BRIEF DESCRIPTION OF THE DRAWINGS--;

Page 10, before line 14, insert the following centered heading before the last paragraph: --DETAILED DESCRIPTION--.

IN THE CLAIMS:

Please cancel all pending claims and replace with the following claims 1-12:

--1. Method for irradiating objects with infrared radiation, in particular in order to dry surface layers and/or fix them in place, wherein a radiation source (10) is moved by means of a robot (1) into one or several operating positions in which the particular target object is irradiated, characterized in that the radiation is emitted by a thermal radiator (12) with a surface temperature of more than 2000 K, in particular more than 2500 K, and the infrared radiation has a spectral radiance maximum in the near infrared.--

--2. Method according to Claim 1, wherein the radiation source (10) is moved continuously within a range of operating positions in such a way that the infrared radiation sweeps over one or several regions on the surface of the target object.--

--3. Method according to Claim 1, at least one operating position is chosen such that the infrared radiation is directed into a recess or into a cavity in the target object.--

--4. Method according to claim 1, irradiation of the target object is preceded by the beginning of application of a material that is disposed on the surface and/or in joints, cavities or similar recessed spaces in the target object and that is dried and/or fixed by the irradiation.--

--5. Method according to Claim 4, wherein the application of the material is also performed by a robot, which moves an application device into one or several operating positions.--

--6. Method according to Claim 5, wherein the sequence of movements of the robot used for application and that of the robot (1) used for irradiation are the same, at least in part, and/or the two robots' movement paths are at least partially congruent.--

--7. Method according to claim 1, a plurality of target objects are irradiated consecutively by the same radiation source (10), such that the same robot (1) moves the radiation source (10) and from the standpoint of the target objects the radiation source (10) progresses through the same movement path in each case.--

--8. System for irradiating objects with infrared radiation, in particular in order to dry surface layers and/or fix them in place, with

a radiation source (10) operating in the near infrared to generate the infrared radiation and

a robot (1) to move the radiation source (10) into one or several operating positions, in which the target object is irradiated, wherein the radiation source (10) is combined with a reflector (13) to reflect infrared radiation from the radiation source (10) in the direction of one or several target objects, and wherein the reflector (13) can be moved together with the radiation source (10) by the robot (1).--

--9. System according to Claim 8, wherein the robot (1) comprises a holder (6) to contain the radiation source (10), such that the holder (6) is connected, by way of a pivotable and/or linearly movable robotronic mechanism (2...6), to a supporting device (7) to keep the robot (1) stably supported in a fixed location.--

--10. System according to Claim 9, wherein the robotronic mechanism (2...6) can be swivelled about multiple axes of rotation, in particular six axes.--

--11. System according to claim 8, the reflector can be moved independently of a movement of the radiation source, in particular can be folded upward, in such a way that in an operating position it can be directed so as to concentrate the irradiation onto the target object or objects.--

--12. Application of a halogen lamp (10) as a radiation source in carrying out the method according to claim 1, such that the halogen lamp (10) together with a reflector (13) is moved by a robot (1) into one or several operating positions in which the particular target object is irradiated.--

REMARKS

The present preliminary amendment adds proper headings to this Section 371 national stage application as filed, deletes improper references to claims in the specification, and removes multiple dependency from the claims.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version With Markings To Show Changes Made."

A timely Notice of Allowance is respectfully requested.

Respectfully submitted,

Nate F. Scarpelli, Reg. #22,320
MARSHALL, GERSTEIN & BORUN
6300 Sears Tower
233 S. Wacker Drive
Chicago, Illinois 60606
Tel.: (312) 474-6300
Fax: (312) 474-0448

Dated: Sept. 28, 2001

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Page 1, change the heading "DESCRIPTION" to centered heading: --BACKGROUND OF THE INVENTION--.

Page 3, lines 16-21, delete entire paragraph from "These objectives are achieved" to "subordinate claims in each case." and insert centered heading: --SUMMARY OF THE INVENTION--.

Page 10, before line 5, insert the following centered heading before the first full paragraph: --BRIEF DESCRIPTION OF THE DRAWINGS--;

Page 10, before line 14, insert the following centered heading before the last paragraph: --DETAILED DESCRIPTION--.

New Patent Application for: KAI K.O. BÄR, et al.

For: INFRARED IRRADIATION

Mailing Certificate for: Transmittal Letter To The United States Designated/Elected Office (DO/EO/US) Concerning A Filing Under 35 U.S.C. 371

Attorney Docket No.: 27428/37727

"EXPRESS MAIL" mailing label No. EL 564463305 US

Date of Deposit: September 28, 2001

I hereby certify that this paper (or fee) is being deposited with the United States Postal Service "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 CFR §1.10 on the date indicated above and is addressed to the Commissioner for Patents, Box PCT, Washington, D.C., 20231.

Richard Zimmermann

INFRARED IRRADIATION

Description

The invention relates to a method and a system for irradiating objects with infrared radiation, in particular for the purpose of drying surface layers and/or fixing them in position.

For example, a known procedure for the serial lacquering of the surfaces of objects is to transport the objects through a lacquering chamber. This chamber contains a mist of lacquer droplets, which precipitate onto the surfaces of the objects. Subsequently the objects are transported into a drying chamber where the layer of lacquer is dried.

Particularly in the case of objects with irregularly shaped, complicated surfaces it is further known to employ industrial robots that are freely programmable; these can spray nearly uniformly thick layers of lacquer onto the relevant surface regions. By means of the industrial robots it is possible to reach even relatively inaccessible parts of the surface, for instance in the region of recesses, cavities, joints and the like. The industrial robots can also be used to lacquer only specified parts of the surface.

In the manufacture of automobiles industrial robots are similarly employed to seal cavities, for

instance in the wheel cases of a chassis. The pasty or liquid sealing material is disposed on the surface of the cavity by means, for example, of a spray gun carried by the robot.

Drying or fixation of the above-mentioned materials, after they have been applied by the industrial robots, is customarily achieved by passage through a continuous furnace . The time taken for the objects to pass through the furnace is predetermined such that the desired drying or fixation of the applied materials is accomplished. These passage times typically amount to several minutes.

Another known method of drying or fixation is by passing the materials through chambers in which large-area infrared radiators are disposed, for example on the walls of the chamber. These infrared radiators are typically operated at surface temperatures below 1000 K.

In both the continuous furnaces and the radiation chambers, large areas of the surfaces of objects, or even the object as a whole, are unavoidably heated. Material disposed at places on the surface that are hidden and/or difficult to reach, therefore, as a rule can be dried or fixed only by heating the object at least in the region including these places. That is,

drying or fixation occurs by thermal conduction. The heat thus transported must previously have entered the body of the object by way of its surface. Furthermore, it is impossible to begin to dry or fix the applied materials while the process of application is still underway at other places on the surface of the object.

One objective of the present invention is to disclose a method and a system for irradiating objects with infrared radiation that enable a rapidly acting irradiation even of sites that are hard to reach, as well as a spatially restricted irradiation of specified regions of the surface of the object to be irradiated. Another objective is to disclose a means of applying infrared radiation to target objects that is suitable for the method and/or system.

These objectives are achieved by a method with the characteristics given in Claim 1, by a system with the characteristics given in Claim 9, and by an application with the characteristics given in Claim 15. Further developments are the subject matter of the subordinate claims in each case.

In accordance with a central idea of the invention, a source of infrared radiation is moved by means of a robot into one or several operating positions, in which radiation is applied to the

particular target object. The term "robot" designates industrial robots and similar movable apparatus capable of placing the radiation source in the desired operating position or positions. It is advantageous for the robot to be freely programmable, so that within its operating range it can move to any desired position and, preferably, in each of these positions can aim the radiation source in any desired, freely predeterminable direction.

As radiation source a halogen lamp is preferred, which in particular can comprise an annular tube that is transparent to radiation and an incandescent filament that extends through the interior of the tube. Alternatively or additionally, the halogen lamp can comprise at least one straight radiation-transparent tube, with an incandescent filament extending linearly therein.

Preferably the radiation source is combined with a reflector to reflect infrared radiation from the source towards one or several target objects, and the reflector is so disposed that the robot can move it together with the radiation source. In a special embodiment the reflector can be moved independently of any movement of the radiation source, in particular can be folded upward, so that in a given operating position

it can be oriented so as to concentrate the radiation onto the target object or objects. This orientation movement, independent of the movement of the source, can already begin or be completed while the robot is in the process of moving the radiation source. By this means the combination of radiation source and reflector can be brought into relatively inaccessible operating positions, such as into cavities.

The robot advantageously comprises a holder to contain the radiation source, in which case the holder is connected by way of a pivotable and/or linearly movable robotronic mechanism to a supporting device that keeps the robot stably at the desired site. In a manner known per se, the robotronic mechanism can in particular be swiveled about several axes, for example six axes. In this way, by combination with a suitable robot controller, the freely predeterminable and arbitrary position and orientation of the radiation source can be approached and established.

In a further development of the method in accordance with the invention, the radiation source is moved continuously within a range of operating positions, so that the infrared radiation sweeps across one or more surface regions of the target object. The radiation source thus "scans", so to speak, the surface

of the object. By this means even surfaces with the most complicated geometries can be irradiated with a uniform input of energy per unit area. It is also possible, for instance when a coating is being applied to a chassis, to begin the irradiation in one surface region, or in the region of joints, cavities or similar recessed spaces, while at another site material is still being applied. In particular, because of this feature it is no longer necessary to treat the entire surface, i.e. the entire target object or at least large parts thereof, when irradiation or treatment is actually required only in smaller areas of the surface. Hence by means of the invention production times can be shortened and in some circumstances continuous furnaces, irradiation chambers and similar space-consuming equipment can be eliminated.

The invention also makes it possible to treat surface regions that are extremely difficult to access. For example, when low-viscosity materials are applied in recesses or in cavities of the object, the applied material must be rapidly dried or consolidated. There is no time available for the object to be transported to a distant continuous furnace or into an irradiation chamber. Therefore, according to a preferred further development of the method in accordance with the

invention, it is proposed to select at least one operating position such that the infrared radiation can be directed into a recess or a cavity of the target object.

Irradiation with infrared radiation in the sense of the invention can be employed for a great variety of applications. In addition to the drying and/or fixation of surface coatings as mentioned above, examples include the hardening of materials used to fill joints or similar crevices, quality control by means of infrared irradiation, and the heating of an object by irradiation in preparation for subsequent procedures such as the attachment of materials or objects to its surface. Furthermore, the invention is in priciple also applicable for the irradiation of objects with electromagnetic radiation in other wavelength regions, for instance in the ultraviolet or the visible region.

The invention can be employed to particular advantage when the irradiation of a target object is preceded by the beginning of application of a material that is to be disposed on the surface and/or in joints, cavities or similar recesses in the target objects and is to be dried or fixed by irradiation. Then the application of the material can advantageously also be

done by means of a robot, which moves the applying device into one or several operating positions. In a further development, the sequence of movements of the robot used for application and that of the robot used for irradiation are the same, at least in part, and/or the movement paths of the two robots are at least partially congruent. The robot used for applying the material can either be the same one as is used for irradiation of the object, or another robot. In either case, this embodiment offers the advantage that the robot or robots can be controlled in the same or a similar manner for both procedures. For example, a computer program can be used to control the robot or robots in the same or a similar way.

It is especially preferred to use infrared radiation in the near infrared, i.e. in the wavelength region between the visible and 1.5 micrometers wavelength. Accordingly, in particular a radiation source is used that has a thermal radiator designed for the emission of electromagnetic radiation at surface temperatures of more than 2000 K, in particular more than 2500 K. Operation at such high surface temperatures offers the advantage that, according to Plank's radiation law, the radiance of the emitted radiation increases about as the fourth power of the

absolute surface temperature (provided that the emissivity is approximately independent of temperature). At the high temperatures proposed here, therefore, the amount of energy required for the particular purpose of the irradiation can be transferred to the irradiated object in a short time. Hence it is especially preferred to use radiation sources with thermal radiators that can be operated at surface temperatures of more than 3000 K. In this case the energetic maximum of the emitted radiation is at wavelengths below 1 micrometer. A further advantage of the short irradiation times attainable with appropriately high radiation flux densities lies in the slight degree to which the irradiated object as a whole is heated. That is, the surfaces of the object or the layers disposed on the surface can be heated thoroughly in a short time, which is insufficient for heat to be conducted through the whole body of the object. By adjusting the spectrum of the incident radiation in accordance with the absorption properties of the surface of the target object, or the layers covering that surface, it is even possible to limit the heating to a specified depth. For example, if the absorptance of a surface layer is distinctly lower than 1, but nevertheless because of the thickness of the surface

layer almost all the radiant energy is absorbed in the surface layer, then although the surface layer is thoroughly heated, there is no appreciable heating of the underlying layer or layers.

With reference to the attached drawing, exemplary embodiments of the present invention will now be explained in detail. However, the invention is not restricted to these exemplary embodiments. The individual figures in the drawing are as follows:

Fig. 1 shows a system for the irradiation of objects with infrared radiation, and

Fig. 2 shows the axes of rotation of a six-axis robot similar to that shown in Fig. 1.

The schematic drawing in Fig. 1 shows a robot 1 that carries a halogen radiator 10. Here the robot 1 and the halogen radiator 10 are in the standby position. The robot 1 can move out of this position so as to put the radiator 10 into various operating positions and orient the radiator 10 in such a way that pre-programmed surface regions of a target object (not shown) can be irradiated with a specified radiation flux density and for a specified period of time. The sequence of movements of the robot 1 required for this purpose is controlled by a control unit 15, as is the time during which an electric current is turned on in

order to produce the desired amount of infrared radiation. The control unit 15 is connected, by way of a cable comprising control leads 16, to a stand 7 on which the robot 1 is mounted. From there each of the individual control leads runs to its particular connector.

The robot 1 comprises six axes of rotation, as shown in Fig. 2. Axis 1 is vertically oriented; about this axis a carousel 5 of the robot 1 can be swivelled with respect to the stand 7. With respect to the carousel 5, in turn, a rocker 3 of the robot 1 can be swiveled about the horizontally oriented axis II. At the upper end of the rocker 3 is the axis III, about which an arm 4 of the robot 1 can be swiveled with respect to the rocker 3. The axis III runs parallel to the axis II. At the front end of the arm 4 is the device holder 6. However, the arm 4 is not in itself immovable but rather offers three more opportunities for rotational movements. First, the whole front part of the arm 4 can be rotated about the long axis of the arm 4 (i.e., about the axis IV) with respect to the back part, which is pivotably connected to the rocker 3. In the front part of the arm 4 is a central hand 2 that can be swiveled about the axis V, which is oriented transverse to the long axis of the arm 4.

Finally, the device holder 6 can be rotated about the axis VI, which is oriented perpendicular to the axis V. When the robot is arranged as represented in Fig. 2, the axes IV and VI are identical. However, if the central hand 2 is rotated out of the position shown there, about the axis V, the position of the axes IV and VI relative to one another changes, in such a way that the latter two axes lie in a common, vertical plane.

As shown in Fig. 1, a halogen radiator 10 is attached to the device holder 6, so that the radiator 10 can be moved according to the various possible directions of rotation described above. The radiator 10 comprises two straight quartz-glass tubes 11 disposed parallel to one another, within each of which a halogen atmosphere is enclosed by an air-tight seal; each tube 11 contains a tungsten incandescent filament 12 that runs along the long axis of the tube. Because the filaments 12 are extremely thin and hence have only an extremely small thermal mass, when the electric current through the filaments 12 is turned on, the desired temperature, which corresponds to the magnitude of the electric current, is reached within a few fractions of a second. Then the surface temperature of the tungsten filaments 12 is preferably about 3100 K.

The two quartz-glass tubes 11 are supported at their ends by a holder (not shown) fixed to the carrier element 14. The carrier element 14 is hollowed out to conform to the shape and position of the two quartz-glass tubes 11; this configuration serves to provide a reflector 13 to reflect the infrared radiation that is emitted in the backward direction by the tungsten filaments 12. The carrier element 14 is shown in Fig. 1 as though cut open at its side. The reflective surface of the reflector 13 consists of polished aluminum and as represented in Fig. 1 is shaped approximately like a double parabola.

The system shown in Fig. 1 is used, for example, in the manufacture of automobile chassis to dry pasty or liquid materials that have been applied to the surface of the chassis in concealed places, such as in wheel cases or similar cavities. To shorten the production time, drying by means of the robot 1 and the halogen radiator 10 begins immediately after the liquid or pasty materials have been disposed here, while these materials are still being applied to other parts of the chassis. Application of the liquid or pasty materials is also carried out by means of a robot constructed in the same way as the robot 1. This robot, which is not shown here, moves a spray nozzle into the operating

position, whereupon the liquid or pasty material is sprayed onto the chassis. The nozzle and the halogen radiator 10 are so designed and are so operated that the device holder 6 (or the device holder of the other robot) is at the same distance from the surface to be dried during spraying as during drying. Therefore the two robots can carry out the same sequence of movements in order to bring the spray nozzle or the halogen radiator 10 into the operating position. After the spraying in one region has been completed, the chassis needs merely to be transported a short distance further to put this region, which now needs to be dried, into a position that can be reached by the robot 1. With this system, the apparatus for controlling two robots is not substantially more elaborate than that needed to control one robot. In particular, the movement sequence programmed in the control unit 15 can be executed twice, approximately identically, in succession with some time delay.

List of Reference Numerals

1 Robot

2 Central hand

3 Rocker

4 Arm

5 Carousel

6 Device holder

7 Stand

10 Halogen radiator

11 Quartz-glass tube

12 Tungsten incandescent filament

13 Reflector

14 Carrier element

15 Control unit

16 Control leads

I-VI First to sixth axis of rotation

AMENDED CLAIMS DURING THE INTERNATIONAL PHASE

1. Method for irradiating objects with infrared radiation, in particular in order to dry surface layers and/or fix them in place, wherein a radiation source (10) is moved by means of a robot (1) into one or several operating positions in which the particular target object is irradiated, characterized in that the radiation is emitted by a thermal radiator (12) with a surface temperature of more than 2000 K, in particular more than 2500 K, and the infrared radiation has a spectral radiance maximum in the near infrared.

2. Method according to Claim 1, wherein the radiation source (10) is moved continuously within a range of operating positions in such a way that the infrared radiation sweeps over one or several regions on the surface of the target object.

3. Method according to Claim 1 or 2, wherein at least one operating position is chosen such that the infrared radiation is directed into a recess or into a cavity in the target object.

4. Method according to one of the claims 1 to 3, wherein irradiation of the target object is preceded by the beginning of application of a material that is disposed on the surface and/or in joints, cavities or similar recessed spaces in the target object and that is dried and/or fixed by the irradiation.

5. Method according to Claim 4, wherein the application of the material is also performed by a robot, which moves an application device into one or several operating positions.

6. Method according to Claim 5, wherein the sequence of movements of the robot used for application and that of the robot (1) used for irradiation are the same, at least in part, and/or the two robots' movement paths are at least partially congruent.

7. Method according to one of the claims 1 to 6, wherein a plurality of target objects are irradiated consecutively by the same radiation source (10), such that the same robot (1) moves the radiation source (10) and from the standpoint of the target objects the radiation source (10) progresses through the same movement path in each case.

8. System for irradiating objects with infrared radiation, in particular in order to dry surface layers and/or fix them in place, with

a radiation source (10) operating in the near infrared to generate the infrared radiation and

a robot (1) to move the radiation source (10) into one or several operating positions, in which the target object is irradiated, wherein the radiation source (10) is combined with a reflector (13) to reflect infrared radiation from the radiation source (10) in the direction of one or several target objects, and wherein the reflector (13) can be moved together with the radiation source (10) by the robot (1).

9. System according to Claim 8, wherein the robot (1) comprises a holder (6) to contain the radiation source (10), such that the holder (6) is connected, by way of a pivotable and/or linearly movable robotronic mechanism (2...6), to a supporting device (7) to keep the robot (1) stably supported in a fixed location.

10. System according to Claim 9, wherein the robotronic mechanism (2...6) can be swivelled about multiple axes of rotation, in particular six axes.

11. System according to one of the claims 8 to 10, wherein the reflector can be moved independently of a movement of the radiation source, in particular can be folded upward, in such a way that in an operating position it can be directed so as to concentrate the irradiation onto the target object or objects.

12. Application of a halogen lamp (10) as a radiation source in carrying out the method according to one of the claims 1 to 7, such that the halogen lamp (10) together with a reflector (13) is moved by a robot (1) into one or several operating positions in which the particular target object is irradiated.

INFRARED IRRADIATION

Abstract

The invention relates to a method and a system for irradiating objects with infrared radiation, in particular in order to dry surface layers and/or fix them in place, wherein a radiation source (10) is moved by means of a robot (1) into one or several operating positions in which the particular target object is irradiated.

Inventor: Bar, et al.
Sheet No.: 1 of 1
Figure No(s).: 1 and 2

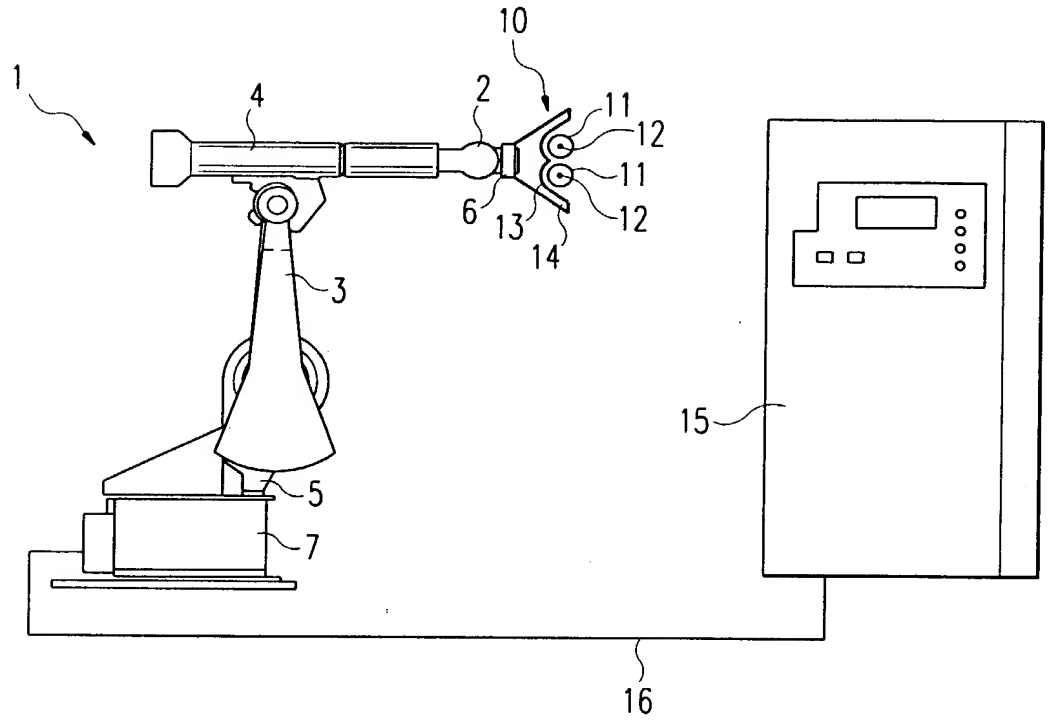

Fig. 1

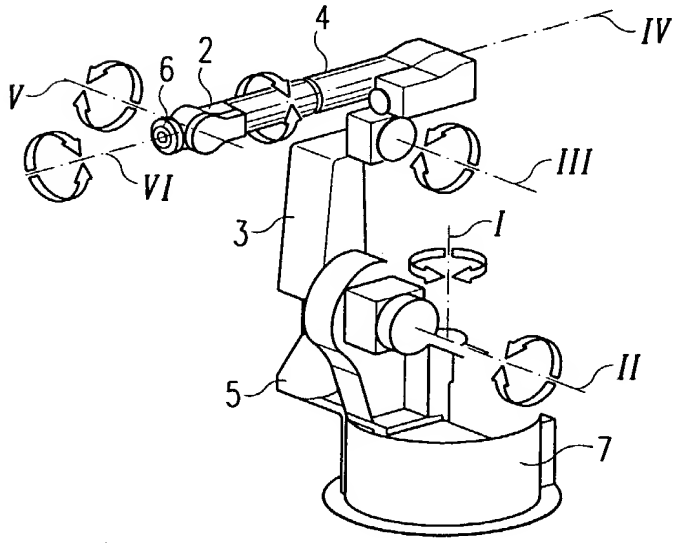

Fig. 2

DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled "**INFRARED IRRADIATION**," the specification of which (check one): ☐ is attached hereto; ☒ was filed on Sept. 28, 2001 as Application Serial No. 09/937,995 and was amended on ______ (if applicable); ☒ was filed as PCT International Application No. PCT/EP00/02773 on March 29, 2000 and was amended under Article 19 on ______ (if applicable). I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

(Application Serial Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed
DE 19915059.1	Germany	1 April 1999	☒ Yes ☐ No
			☐ Yes ☐ No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below:

(Application Serial Number)	(Day/Month/Year Filed)

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in 37 C.F.R. §1.56 which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

(Application Serial Number)	(Day/Month/Year Filed)	(Status-Patented, Pending or Abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: I hereby appoint as my attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

(24)

John B. Lungmus (18,566)	Richard H. Anderson (26,526)	Martin J. Hirsch (32,237)	James A. Flight (37,622)
Allen H. Gerstein (22,218)	Patrick D. Ertel (26,877)	James J. Napoli (32,361)	Roger A. Heppermann (37,641)
Nate F. Scarpelli (22,320)	Richard B. Hoffman (26,910)	Richard M. La Barge (32,254)	David A. Gass (38,153)
Michael F. Borun (25,447)	James P. Zeller (28,491)	Douglass C. Hochstetler (33,710)	Gregory C. Mayer (38,238)
Trevor B. Joike (25,542)	Kevin D. Hogg (31,839)	Robert M. Gerstein (34,824)	Michael R. Weiner (38,359)
Carl E. Moore, Jr. (26,487)	Jeffrey S. Sharp (31,879)	Anthony G. Sitko (36,278)	William K. Merkel (40,725)

Send correspondence to: Nate F. Scarpelli

FIRM NAME	PHONE NO.	STREET	CITY & STATE	ZIP CODE
Marshall, Gerstein & Borun	312-474-6300	6300 Sears Tower 233 South Wacker Drive	Chicago, Illinois	60606-6402

1-00

Full Name of First or Sole Inventor KAI K.O. BÄR	Citizenship German
Residence Address - Street Bruckmühler Straße 27	Post Office Address - Street Bruckmühler Straße 27
City (Zip) Bruckmühl 83052	City (Zip) Bruckmühl 83052
State or Country Federal Republic of Germany DEX	State or Country Federal Republic of Germany
Date ☒ 30th of November 2001	Signature ☒

Second Joint Inventor, if any RAINER GAUS	Citizenship German
Residence Address - Street Bruckmühler Straße 27 DEX	Post Office Address - Street Bruckmühler Straße 27
City (Zip) Bruckmühl 83052	City (Zip) Bruckmühl 83052
State or Country	State or Country
Date ☒ 30th of November 2001	Signature ☒

Third Joint Inventor, if any	Citizenship
Residence Address - Street	Post Office Address - Street
City (Zip)	City (Zip)
State or Country	State or Country
Date ☒	Signature ☒

Fourth Joint Inventor, if any	Citizenship
Residence Address - Street	Post Office Address - Street
City (Zip)	City (Zip)
State or Country	State or Country
Date ☒	Signature ☒

APPLICABLE RULES AND STATUTES

37 CFR 1.56. DUTY OF DISCLOSURE - INFORMATION MATERIAL TO PATENTABILITY (Applicable Portion)

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and
(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentability defines, to make sure that any material information contained therein is disclosed to the Office.

Information relating to the following factual situations enumerated in 35 USC 102 and 103 may be considered material under 37 CFR 1.56(a).

35 U.S.C. 102. CONDITIONS FOR PATENTABILITY: NOVELTY AND LOSS OF RIGHT TO PATENT

A person shall be entitled to a patent unless --

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

(c) he has abandoned the invention, or

(d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraph (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

35 U.S.C. 103. CONDITIONS FOR PATENTABILITY; NON-OBVIOUS SUBJECT MATTER (Applicable Portion)

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

35 U.S.C. 112. SPECIFICATION (Applicable Portion)

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.